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TAGUNGSBERICHTE
INTERNATIONALES SYMPOSIUM
**DIE RADIOÖKOLOGIE, ANGEWENDET AUF DEN
SCHUTZ DES MENSCHEN UND SEINER UMWELT**

ACTES
SYMPOSIUM INTERNATIONAL
**LA RADIOÉCOLOGIE APPLIQUÉE A LA PROTECTION
DE L'HOMME ET DE SON ENVIRONNEMENT**

ATTI
SIMPOSIO INTERNAZIONALE
**RADIOECOLOGIA APPLICATA ALLA
PROTEZIONE DELL'UOMO E DEL SUO AMBIENTE**

VERSLAG
INTERNATIONAAL SYMPOSIUM
**DE RADIOECOLOGIE TOEGEPAST OP DE
BESCHERMING VAN DE MENS EN ZIJN OMGEVING**

PROCEEDINGS
INTERNATIONAL SYMPOSIUM
**RADIOECOLOGY APPLIED TO THE
PROTECTION OF MAN AND HIS ENVIRONMENT**

ROMA, 7-10 SETTEMBRE 1971

Generaldirektion Soziale Angelegenheiten - Direktion Gesundheitsschutz
Direction Générale des Affaires Sociales - Direction Protection Sanitaire
Direzione Generale Affari Sociali - Direzione Protezione Sanitaria
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A RE-EXAMINATION OF PLUTONIUM AT THULE, GREENLAND, IN 1970

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SUMMARY - After the accidental release of plutonium at Thule in January 1968 a radioecological study was carried out in the following summer. Increased plutonium levels appeared in samples collected as far as 15 Kilometers from the point of impact. Especially bottom animals showed increased levels. To investigate the geographical distribution as well as the migration of plutonium in the food-chains at Thule a re-examination was undertaken in August 1970. As in 1968 samples of seawater, bottomsediments, bottomanimals, zooplankton, fish, seabirds, seals, seaplants and lichen were collected. The investigation showed that although the levels in most samples had decreased since 1968 plutonium was still present in concentrations significantly above the fallout background. Samples of bottom sediments showed a vertical movement of plutonium in the sediments down to a depth at least 10 cm. Bivalves as far as 30 Kilometers from the point of impact contained plutonium from the accident.

(1) and (2) show that the activity from the accident has moved to greater distances since 1968. The calculation of the total integrated level of ^{239}Pu indicates that the amount has remained unchanged from 1968 to 1970. The difference between the estimates for the two years is explained by the considerable uncertainties of an estimate such as this.

In 1968 we estimated the ^{239}Pu content in sediments at $3 \text{ Ci}^{(2)}$. This result was considerably lower than the present values, because the earlier estimate did not account for the penetration of plutonium down through the sediments to greater depths than approx. 1 cm. It is the experience also of other investigators⁵⁾ that plutonium moves down through the sediments, perhaps as a result of water movements (at Thule there is a strong tidal current which stirs up the sediments) or on account of biological processes, e.g. the action of worms and other bottom animals.

Bivalves

The other important sample object in 1970, as well as in 1968, was bivalves. We analysed 122 samples comprising the species: Macoma, Chlamys, Astarte, Musculus, Hiatella, Leda, and Chlamys. The plutonium content of bivalves varied in the same way as in sediments and could at distances of more than 2 km from the point of impact be described by equations (3) and (4) shown in table 2.

Table 2

^{239}Pu /kg soft tissue (y) of bivalves collected at Thule in 1968 and 1970

Year	Equation	No. of samples	Coeff. of correlation r	Signif. level of r	Integrated level of ^{239}Pu in Ci (for bio. mass 0.5 kg/m^2)			
					0-2 km	>2-7.5 km	>7.5 km	Total
1968	$y = 531e^{-0.25x}$ (3)	33	0.47	>99%	17 (10 samples)	8	3	28
1970	$y = 39e^{-0.085x}$ (4)	95	0.64	>99.9%	2 (27 samples)	1	4	7

a) b) c) d) cf. the corresponding remarks to table 1

The plutonium content in the soft tissue of bivalves has decreased by a factor of four from 1968 to 1970. As the variation of the activity with distance is the same for bivalves as for sediments, it is likely that the ^{239}Pu in the soft parts of bivalves is present as PuO_2 particles taken up from the sediments either by a surface contamination of the animals or by some biological process. Whether the plutonium is metabolized is at the moment a question open to further investigation.

Sea Water

The analysis of sea water samples gave no indication of elevated plutonium concentrations at Thule. The nine samples collected in 1970 varied from 0.6 to $3 \text{ fCi } ^{239}\text{Pu/litre}$, and these levels were not significantly different from the fall-out background.

Bottom Animals

Fifty-two samples were analysed. The samples consisted mostly of worms and starfish. The worms followed the equation:

$$\text{pCi } ^{239}\text{Pu/kg soft tissue} = 200 e^{-0.086x} \quad (5)$$

When this equation is compared with the corresponding equations for sediments (2) and bivalves (4), it is evident that the activity in worms varies in the same way with distance as in the other samples: the plutonium levels are reduced by a factor of 10 for each 20 km we move away from the point of impact.

Starfish was also treated by a regression analysis, but showed no significant correlation with distance. This is probably a result of the greater mobility of starfish than of worms and bivalves.

Other Samples

Shrimps and fish (mostly polar cod, Agonidae, and sea scorpion) showed in 1970 plutonium levels 10 times above the fall-out background, but 10-100 times below the levels observed in 1968²⁾.

Sea weed, zooplankton, sea birds, and seals did not differ significantly from the fall-out background. Hence we may conclude that the plutonium from the Thule accident in 1968 had not moved to the higher links of the food chain by 1970.

Conclusion

Since 1968 the plutonium from the Thule accident has moved and was in 1970 detectable as far as 30 km from the point of impact. Although bottom animals still contained elevated levels of ^{239}Pu from the accident, the levels were significantly less than in 1968. Plutonium in bivalves had thus decreased by a factor of four. The higher animals of the local food chains showed no indication of increased ^{239}Pu levels. The total amount of ^{239}Pu in the marine environment at Thule was estimated at 20 Ci or 320 g.

Acknowledgement

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References

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DISCUSSION - DISCUSSION - DISCUSSION - BERAADSLAGING - DISCUSSION

- ORTINS-BETTENCOURT (Portugal):

Quelle est l'épaisseur des sédiments qui peut être considérée contaminée?

- AARKROG (Denmark):

90-95% of the plutonium were present in the upper 10 cm. of the sediments. 2/3 were found in the upper 3-4 cm.

- ROUX (France):

Avez-vous constaté une éventuelle migration en profondeur du plutonium dans la glace en l'absence de fonte de celle-ci?

- AARKROG (Denmark):

No I have not been studying this problem.